PSC-410/411 S452

OPERATION AND MAINTENANCE INSTRUCTION MANUAL

NORTH ATLANTIC *industries, inc.*

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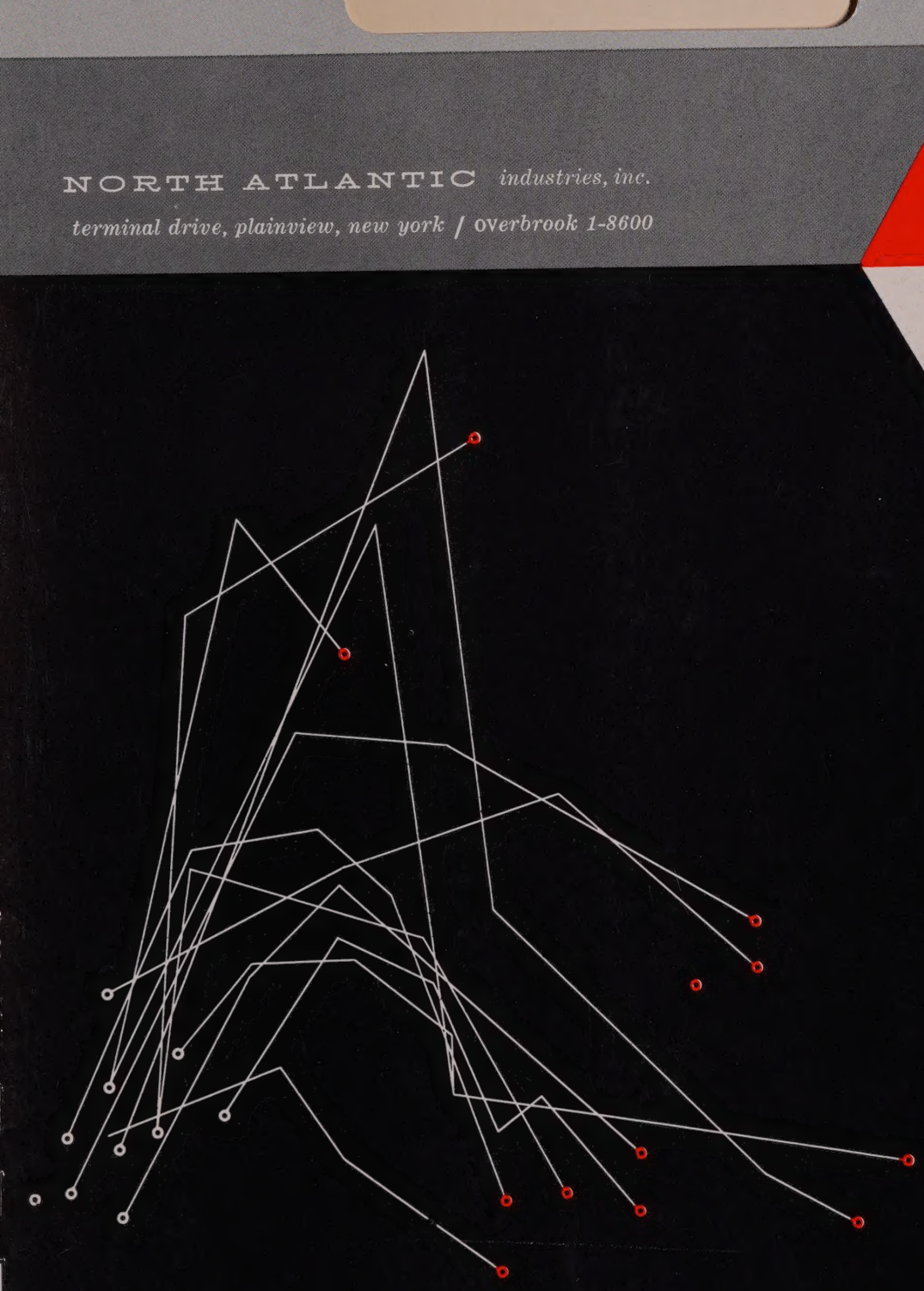

AUTOMATION · CONTROL SYSTEMS · INSTRUMENTATION

PSC-410/411 5450

OPERATION AND MAINTENANCE

INSTRUCTION MANUAL

NORTH ATLANTIC INDUSTRIES, INC.
Plainview New York

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Signal Input Impedance: 1 megohm

NOTE: When used with optional shielded transformer for balanced input, the impedance is approximately 300,000 ohms at 400 cps with a self-resonance at 1,500 cps on the low ranges, 1 megohm on higher ranges (10 volts and above).

Reference Input Impedance: 100,000 ohms

Load Impedance: 10,000 ohms resistive, adjustable (±10%) to obtain desired scale factor.

Programming: Positive or negative 28V D.C. (±4V) pulses for switching magnetic latching relays to program ranges, function modes and input modes. (See Section II, "Programming").

Reference Input: 100 to 130V at frequency of operation ±5% (special units, at other voltage ratings).

Temperature: 0°C to 55°C (special units, over other temperature ranges).

Input Power: 115V, ±5%, 50 to 440 cps - to be fused for 0.1 amp. - 6 watts at 60 cps.

Plus or minus 28V D.C. (±4V), 18 watts, 4 milliseconds (minimum) pulse for programming.

Noise: At zero input signal: D.C. output, 3 millivolts maximum.

At 1V input signal: A.C. output, 6 millivolts RMS maximum.

Options: Optional isolation transformers available for either signal or reference channels. (For PSC-411, a reference transformer must be used externally where it is not included within the unit.)

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SECTION I

SPECIFICATIONS

General: The Phase Sensitive Converter converts A.C. signals to D.C. outputs precisely proportional to either the magnitude of the input voltage, or to the product of the voltage and the sine or cosine of the input phase angle. Ground isolation or differential summing may be accomplished by use of a shielded input transformer.

Output Voltage: 0 to ±10V, D.C.

Input Voltage: Full Scale Reading (10V, D.C. Output)

PSC-410:	1.0V to 1,000V in 4 separate decade ranges
PSC-411:	0.01V to 1,000V in 6 separate decade ranges

(300V RMS maximum on 1,000V scale)

Function Modes: Total, Fundamental, In-Phase, Quadrature

Frequency Range:

Total	-	350 cps - 10KC (special units, 60 cps to 10KC)
Fund	-	Frequency of operation, ±5%
In-Phase	-	Frequency of operation, ±5%
Quad	-	Frequency of operation, ±5%

Accuracy:

Total	-	0.1% full scale linearity to 1KC, degrading to 1% at 10 KC
Fund	-	0.1% full scale linearity
In-Phase	-	0.1% full scale linearity
Quad	-	0.1% full scale linearity
Orthoganality	-	±0.05°

Settling Time: The settling time, defined as the time to settle to within 0.1% of final value is less than 100 milli-seconds.upon application of a step input.

NOTE: The above applies to all units with frequency of operation of 400 cps or greater. For all units at lower frequency of operation, as well as units with extended total range down to 60 cps, the settling time is less than 1.0 seconds.

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SECTION II

GENERAL DESCRIPTION

The Phase Sensitive Converter is a precise A.C. to D.C. instrument which is capable of transforming A.C. signal to accurate, proportional, D.C. outputs. The phase sensitive D.C. output provided may also be used to precisely measure phase angle of the A.C. input.

The instrument may be used, with the FUNCTION selection in the "TOTAL" mode, to indicate the total A.C. signal content over a frequency range of 350 cps to 10 KC (50 cps to 10KC on special units). The fundamental component of the signal may be obtained with the FUNCTION selection in the "FUND" mode. The in-phase component (E cos θ), and the quadrature component (E sine θ) may be obtained from the equipment with FUNCTION in the "IN-PHASE", and "QUAD" modes, respectively. An output voltage of 0 to 10V D.C. will be obtained for any full scale, A.C. input voltage with in the available input ranges. Refer to Section I, "Input Voltage Range".

This basic package has been designed to incorporate shielded reference and/or signal isolation transformers, which provide a means for ground isolation or a means for differential summing. Units equipped with the signal isolation transformer will include the input program shown in Figure 5.5 (Page 5.13). Where the internal reference isolation transformer is not included, an external reference isolation transformer is highly recommended to simplify external system wiring.

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SECTION III

OPERATING INSTRUCTIONS

(See Figures 5.1 & 5.2)

Before supplying power to the converter, be sure that a 10,000 ohms (nominal) resistance is connected across pins C and D of connector J6. A 10,000 ohms resistor (nominal) should also be connected between pins C and F of this connector. THE INSTRUMENT WILL NOT FUNCTION PROPERLY IF THIS IS NOT DONE.

The power, 115V, 50 to 440 cps, is applied to pins A and B of connector J7. The components of the converter will require a short warm-up period before a stable operating condition is reached.

Apply input signal to pins A and B of connector J6, with pin B used as low side for "direct" input applications. The A.C. reference input is applied to pins E and F of connector J6.

NOTE: For either "direct" or "transformer" input, the voltage at pin E is in phase with the voltage at pin A.

Positive phased D.C. output will appear across pins C and D of connector J6, with C as high side and D as low side. Negative phased D.C. output will appear across pins G (high) and H (low).

1. Programming

Function, Range and Input

The desired operating condition may be selected by applying a ±28V D.C. (±4 V) pulse to the appropriate pins of connector J8, for a minimum of 4 milliseconds. This pulse is all that is required by the magnetic, latching-type relays for operation. Note that the programming is a function of the D.C. polarity.

Function Selection

The FUNCTION switching is used to select the desired mode of operation. One of four available modes may be selected.

"TOTAL" The D.C. output signal is proportional to the entire A.C. input signal (RMS).

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"FUND" The D.C. output signal is proportional to the RMS magnitude of the fundamental component of the input signal.

"IN-PHASE" The D.C. output signal is proportional to that component of the RMS input signal which is in phase with the reference signal.

"QUAD" The D.C. output signal is proportional to that component of the RMS input signal which is in quadrature with the reference signal.

Range Selection

The Range Switching is used to select the appropriate sensitivity as defined by that full scale A.C. input corresponding to 10V D.C. full scale output. In effect, the proper range scaling attenuators are chosen by this control.

Input Selection (Instruments Equipped with Isolation Transformer only)

The input Selector is used to select either a direct (capacitor) or transformer coupled input. The direct mode is used with a single ended input. The transformer permits use with a floated or differential measurement, the lower impedance input should be connected to pin A of J6.

2. Operation

Scale Factor Adjust

Adjust 10,000 ohms load resistance across pins C and D, and the 10,000 ohms resistance across pins G and H, so that the output voltage measures 10V ±0.1%, using a measurement technique which will not load these resistances.

SECTION IV

THEORY OF OPERATION

1. General

The block diagrams and schematics of Figures 5.1 and 5.2 serve to illustrate the principles of operation of the Phase Sensitive Converter.

The PSC-410, which has a 1 volt full scale maximum sensitivity, has the input signal applied through a capacitor to wide band attenuators. The output of these range attenuators is then applied to a very high input impedance amplifier having unity transfer (Z1). For all function modes except "TOTAL", the output of Z1 is fed through a filter L1, and into a stable broadband amplifier, which essentially adds no further phase shift to the signal. In the "TOTAL" position (see schematic, Figure 5.2) an RC network is inserted between Z1 and Z2 to simulate the transfer of the filter network and yet maintain the "Broadband" capability required in this mode of operation. The output of amplifier Z2 then drives the demodulator circuit (Z5), output filters (L3 and L4) and load, through the signal output transformer (T2). The actual output current is sampled and fed back through a unique, proprietary, arrangement to maintain linearity and phase stability.

In the "TOTAL", as well as the "FUND" mode the demodulator is arranged as a full wave diode rectifier circuit. In the phase sensitive modes the diodes are switched out of the circuit and replaced by transistors. The transistors of this demodulator circuit are gated by the reference channel output. The above mentioned feedback is maintained in all modes, thus, minimizing non-linearities and calibration shifts due to any ageing of components that may conceivably exist. The result is a constant D.C. current in the load proportional to the selected component (by function mode control) of the input A.C.

The PSC-411 has a 10 millivolt full scale maximum sensitivity. In the 10mv., 100mv, and 1v scales the input signal in this unit is applied through a capacitor to amplifier Z1A. In the 10 volts, 100 volt and 1,000 volt scales the signal is attenuated by 1,000 to 1 and then applied through a three scale attenuator to Z1B, which is a high gain operational amplifier. The output of Z1B feeds amplifier Z2 through the same filter-network combination described above (refer to Figure 5.2)

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The 115 volt reference is applied through an isolation transformer, (either external or internal) to prevent ground loops. With the FUNCTION selector in the "QUAD" position, the reference signal is applied to a 90° network. This network maintains the 90° phase shift over the specified band of 5% variation in source frequency. Special units are designed which will accept other input voltages. In any case (see schematic), there is an attenuation of signal level associated with the phase shift network. When in the "IN PHASE" function mode, a resistive attenuator is used to simulate the level change of the 90° network. The result is that in either function mode position the attenuation through the appropriate network used is effectively the same. The output of the network is applied through an isolation amplifier, Z3, to a filter, L2, which is identical to filter L1, in the signal channel. This results in harmonic suppression in both channels, maintaining an identity of transfer.

Although every effort is made to maintain the equality and tracking of the overall phase transfer in both channels under all conditions, wiring differences will undoubtedly occur. In order to permit final phase adjustment of the two channels, the output of filter L2 is applied to a unique, proprietary phasing network, B1. This network permits phase adjustment to be maintained over the 5% frequency range specified. Its output is then applied to the "Reference Square Wave Generator", Z4, resulting in pulses synchronized to the reference input sine wave. These pulses are, in turn, used to trigger the reference output drive, which is contained within, and is part of, the "Reference Driver and Demodulator," Z5.

This "Reference Driver and Demodulator," in effect, performs the ultimate operation of converting the signal channel A.C. to the output D.C. in a phase sensitive manner (see Section IV, paragraph 2, "Amplifiers," below).

The response of the phase sensitive demodulator is limited to signals at the reference frequency as well as to odd order harmonics. All other frequencies are rejected except for signals very near to the response frequency. Here, the output will oscillate between maximum and zero, as the two near frequencies are alternately in-phase, 90° and 180° out-of-phase. Response for this type detector to odd order harmonics will never be greater (usually less depending upon phase angle), than the fundamental response multiplied by a factor 1/n (where n is the order of the harmonic). Since a signal channel filter is used, there is, of course, essentially no response to harmonics in the inputs.

The effect of reference harmonics is much less important than that of signal harmonics because the harmonic content can never do more than shift the point at which the gates start to conduct. Expressed otherwise, there is an equivalent error in degrees which results from harmonics in the reference channel. Since a reference filter is used, only second harmonics are significant. For measurements using the E cos θ characteristic the second harmonic effect is small because the output voltage is a function of current integrated over an entire cycle and the small error produced by distortion has a correspondingly small effect on the total current.

1. Amplifiers

All Phase Sensitive Converters contain solid state circuitry packaged in sealed, potted, humidity-proof, plug-in packages. All designs are based on use of transistors well below maximum manufacturer ratings to insure long life, trouble-free operation. Basically, each amplifier package has a specific function, as described below.

Amplifier Z1 of the PSC-411, and amplifier Z1A of the PSC-411 are identical. This unit is a multitransistor isolation amplifier with extremely high input impedance (between 50 and 100 megohms) and quite low output impedance. Its transfer is effectively unity and exists primarily to permit unloading the input signal source and yet permit proper drive capability of the filter (A1), or range attenuator, as the case may be. The amplifier Z1B, used only on high sensitivity instruments (PSC-411) is a high gain operational amplifier. Range resistors, in conjunction with fixed input and feedback resistors, establish the transfer of this amplifier. Because of the very high effective gain, this amplitude and associated zero phase shift is maintained under all specified conditions. The amplifier is used primarily for the purpose of increasing sensitivity in those units in which it is used.

The amplifier Z2 is a unit designed to operate in conjunction with the demodulator circuit and associated feedback. It has a very high gain-bandwidth product, resulting in a phase-shiftless power gain, while having a voltage transfer of approximately two.

The isolation amplifier, Z3, is used to unload the input 90° (in "QUAD" function mode) and 0° (in "IN-PHASE" function mode) networks and maintain the fixed required low source impedance

for proper operation of the reference filter, L2. It differs from the signal isolation amplifier, Z1 (or Z1A), in that the input impedance requirements are not as stringent as that required of the signal channel.

The Reference Square Wave Generator, Z4, is a circuit which accepts a sine wave input and, when loaded by the "Reference Driver and Demodulator" Z5, emits a series of pulses synchronized to the input sine wave. In effect, this generator (Z4) very accurately squares the input sine wave and then differentiates same into pulses of a high rise time.

The "Reference Driver and Demodulator", Z5, contains the final reference channel output circuitry, which is a multivibrator type circuit, triggered by pulses from the Square Wave Generator (Z4). The output of this portion is applied to transformer, T3, which has six individually floated windings. The center tapped primary is driven directly by the multivibrator. One secondary is used as a feedback winding to complete the basic reference drive circuitry. The other four windings are used to switch the gates in the demodulator section of Z5. The feedback loop, described above, preserves the rise time of the gate switching wave form. The demodulator itself consists of four pairs of transistors which are synchronously gated so as to accurately, phase sensitively, convert the signal output to a D.C. form. This D.C. (containing considerable ripple, of course) is then applied to the output through filters L3 and L4, resulting in a "clean" D.C. In detail, the demodulation may be analyzed by considering the gates as switches which connect the output of the signal channel to filters L3 and L4 (in series with the D.C. load) on alternate half cycles. The complex cross feedback loops contained in the reference and signal channels result in a D.C. output current which is held constant under all specified conditions. Therefore, the exact output scaling, from a voltage standpoint, is strictly dependent upon the stability of the load resistance.

In the "TOTAL" and "FUND" position of the FUNCTION mode selector the four pairs of gated transistors are replaced by four pairs of ungated diodes and the reference channel output is removed. The result is a D.C. operation similar to that described above, with the exception that there is no synchronous gating of the switches.

3. Filters

Filters L1 and L2 are low pass filters designed to cut off at the second harmonic of the operating frequency. Their use in the signal and reference channels permit sufficient rejection of harmonics and noise consistent with the overall instrument specifications.

Filters L3 and L4 are exceedingly flat, low pass, filters with a cutoff at 300 cps. (Special units which go down to 60 cps contain a filter with a 45 cps cutoff.) These filters are designed to result in optimum between maximum filtering of ripple and minimum settling time.

4. Power Supply

The power supply is a transistorized unit using a conventional full wave diode bridge rectifier. The output of the rectifier is filtered and then fed to two Zener diode controlled regulators which independently supply the reference and signal channels. Each regulator is individually fused.

SECTION V

MAINTENANCE

The following section contains instructions for the maintenance and alignment of the Phase Sensitive Converter. It is recommended that these procedures be followed only if proper test equipment is on hand and if sufficiently skilled personnel are available to perform the work.

Cover Removal

To remove cover, remove twelve screws from top and bottom of U shaped cover. It is recommended that a dummy cover with holes cut for access to adjustments be used, in place of normal cover, for precise results.

Component Replacement

Amplifiers

Remove 2 screws from underside of chassis at each amplifier to be removed, except Z4 which has 4 screws. Upon replacement, part numbers must be checked to guarantee proper location. Replace screws on underside of chassis.

Relays

All relays, with the exception of K801, are plug-in relays. To replace these relays, it is necessary to remove the screws which hold the terminal board to the chassis. The relay may then be removed by prying it from its socket. The replacement relay should have sufficient paint removed to insure grounding of its case to the socket. Replace terminal board chassis.

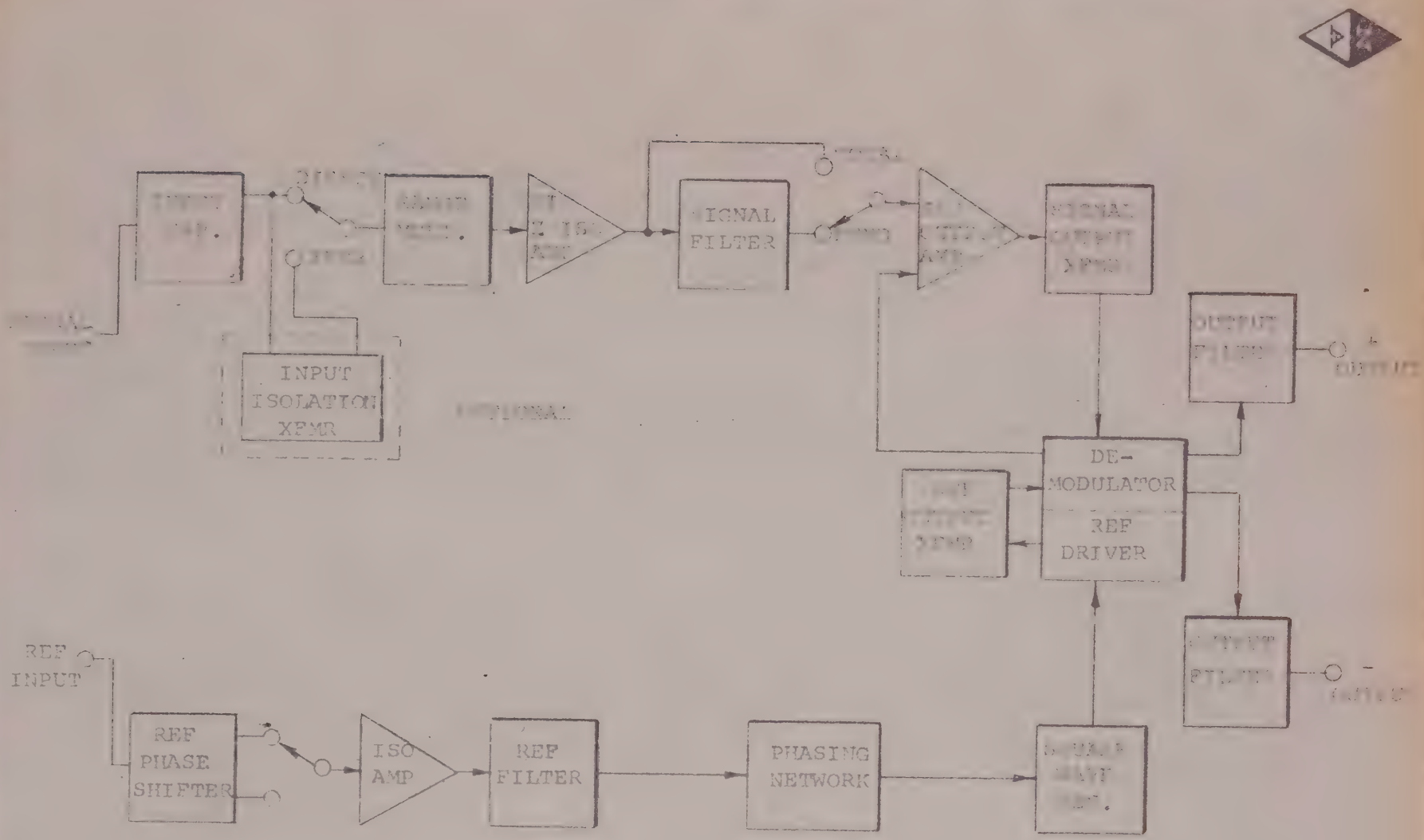
Transistors

There are transistors on TB6 (power supply) which may be replaced with the same type. A heat sink should be used to prevent damage to the transistor.

Fuses

There are two fuse locations at the top of the power supply (TB6) to provide protection for the regulator transistors. These are 0.1 amp, pigtail type, which are soldered in place. They are to be replaced with identical parts, if necessary. In most cases, the opening of one of these fuses implies a malfunctioning elsewhere in the instrument's circuitry. This should be checked before replacement.

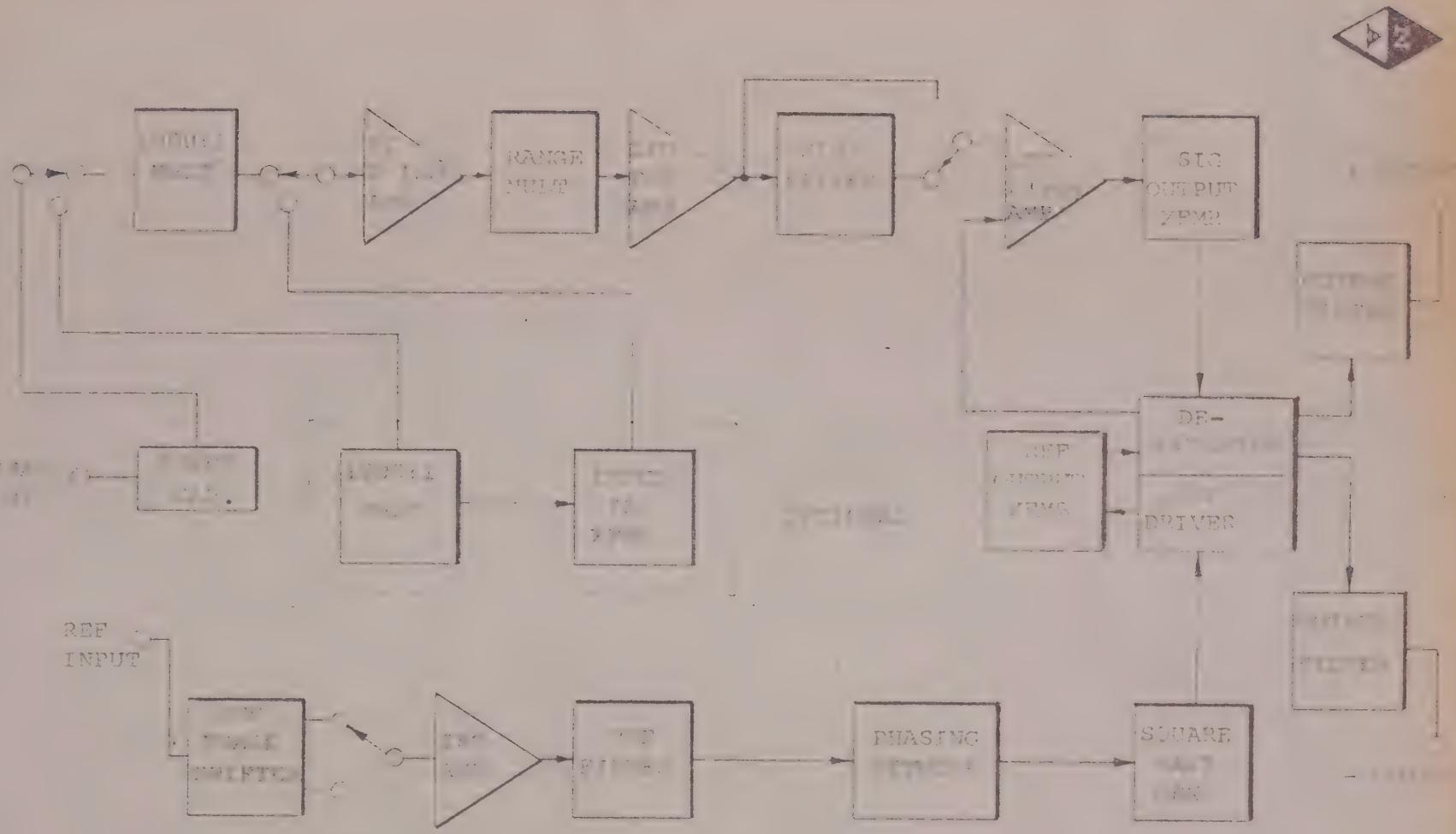
NOTE: Other maintenance adjustments have been described in Section III.



BLOCK DIAGRAM

PCC-410

NOTICE ATLANTIC



BLOCK DIAGRAM

REPLACEMENT PARTS LIST

Designation	Description	Source & Part No.*
C1,C2	Capacitor, 0.5 uf, 600V, ±20%	Hopkins Type P56D
C3	Capacitor, Tantalum 2.2 mfd,20V,±10%	NAI #801779
R1	Resistor, Metal Film,1 meg, 1/2W,1%	NAI #801161
R5	Resistor, Metal Film,LOK,1/2W,1%	NAI #801102
R9,R10	Resistor, Fixed,WW18K, 5W, 3%	NAI#801362
R11	Resistor, Fixed, W.W.,25 ohms, 3W,5%	NAI #800075
R15	Resistor, Fixed, M.F. 175K(Nominal) 1/2W, 1%	NAI #801640
Z1 or Z1A	Amplifier Assembly, High Impedance Isolation	NAI #782049
Z1B	Amplifier Assembly, Signal Preamp.	NAI #782067
Z2	Amplifier Assembly, Signal Output Amp.	NAI #782042
Z3	Amplifier Assembly, Isolation Amp.	NAI #782060
Z4	Amplifier Assembly, Ref. Square Wave Gen.	NAI #782043
Z5	Amplifier Assembly, Ref. Driver & Demod.	NAI #782054
##B1	Phasing Network	NAI #782065-2
J1 Thru J4	Connector, 15 Pin female	Cannon #DASM15-S
J5	Connector, 37 Pin Female	Cannon #DCSM37S
J6	Connector	Bendix SPO2-12-8P
J7	Connector	Bendix SPO2-8-3P
J8	Connector	Bendix SPO2-14-19S

* Part No. given only when no commercial equivalents in size or function are available.

Frequency dependent component, above listing is for 400 cps. For other frequencies see supplement.

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Replacement Parts List (Continued)

Designation	Description	Source & Part No.*
T1,T5	Transformer, Input (Optional)	NAI #B117-2.000-30
T2	Transformer, Signal Output	NAI #200615
T3	Transformer, Ref. Output	NAI #200994
T4	Transformer, Power	NAI #500205
##L1,L2	Filter	NAI #500204-6
L3,L4	Filter	NAI #801030
	(For special 60 cps instruments)	NAI #801429
TB1~		
C101,C102	Capacitor, Mica, Variable 100 uufd	
C103,C104	500uufd	Arco #304
R101	Resistor, 10K,1/2W,1%	NAI #801102
K101,K102		Potter Brumfield
K103,K104	Relay, Plug-in, 28V, D.C.	SL11D
TB5 Assembly		
C501	Capacitor, Tantalum, 2.2ufd, 20V,±10%	NAI #801779
C502,C503	Selected at test	
R501,PSC-411	Resistor,Metal Film,17K,1/2W,1%	NAI #801631
R502		
PSC-410	Resistor,Metal Film,9.8K,1/2W,1%	NAI #801792
R503	Resistor,Variable, 1K (Trimpot)	Bourns Model 3010-L-102 or equal
R504	Selected at test	
R505,PSC-410	Resistor,Metal Film 10K,1/2W,1%	NAI #801102
R506,PSC-410	Resistor,Metal Film,25.7,1/2W,1%	NAI #801793

* Part No. given only when no commercial equivalents in size or function are available.

Frequency dependent component, above listing is for 400 cps. For other frequencies, see supplement.

~ Used with optional input transformer only.

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Replacement Parts List (Continued)

Designation	Description	Source & Part No.*
K501,K502, K503	Relay, Plug-in, 28V D.C. Latching	SL11D' Potter Brumfield,
TB6 (Power Supply Assembly)		
C601,C602, C603,C604, C605	Capacitor, Tantalum, 40 ufd,75V	
R601	Resistor, Comp.,250 ohms, 2W, 10%	
R602,R603	Resistor, Comp., 2.2K,1/2W,5%	
CR601,CR602, CR603,CR604	Diode Silicon, 1N645	
CR605,CR606	Diode, Zener, 30V, 1W, 5%	
Q601,Q602	Transistor, Germanium	T.I. 2N1038
F601,F602	Fuse, .1 amp. subminiature Pigtail	Bussman Type GLN
TB7 Assembly		
C701, C705	Capacitor, Ceramic 3-12 uufd,Variable	
C703	Capacitor, Ceramic, Variable 7-45uufd	
C702,PSC-410	Capacitor,Fixed, Mica,68uufd,500V,5%	
PSC-411	Capacitor,Fixed Mylar,.0068ufd,100V,5%	
C704,PSC-410	Capacitor, Fixed,Mica, 680uufd,300V,5%	
PSC-411	Capacitor,Fixed,Mica,100uufd,500V,5%	
C706,PSC-410	Capacitor, Mylar,.0068 uufd,100V,5%	
PSC-411	Capacitor, Mica, 1000 uufd, 300V,5%	

* Part No. given only when no commercial equivalents in size or function are available.

Designation	Description	Source & Part No.*
TB7 Cont'd		
R703, PSC-410	Resistor, Metal Film, 900K, 1/2W, 1%	NAI #801152
PSC-411	Resistor, Metal Film, 999K, 1/2W, 1%	NAI #801156
R704, PSC-410	Resistor, Metal Film, 100K, 1/2W, 1%	NAI #801153
PSC-411	Resistor, Metal Film, 990 Ohms 1/2W, 1%	NAI #801157
R706, PSC-410	Resistor, Metal Film, 990K, 1/2W, 1%	NAI #801154
PSC-411	Resistor, Metal Film, 50K, 1/2W, 1%	NAI #801360
R707, PSC-410	Resistor, Metal Film, 10K, 1/2W, 1%	NAI #801102
PSC-411	Resistor, Metal Film, 12K, 1/2W, 1%	NAI #801158
R709, PSC-410	Resistor, Metal Film, 999K, 1/2W, 1%	NAI #801156
PSC-411	Resistor, Metal Film, 500K, 1/2W, 1%	NAI #801358
R710, PSC-410	Resistor, Metal Film, 990 Ohms, 1/2W, 1%	NAI #801157
PSC-411	Resistor, Metal Film, 9.5K, 1/2W, 1%	NAI #801359
~R702, R705		
PSC-410	Resistor, Variable, 5K (Trimpot)	Bourns Model 3010-L
R705, PSC-411	Resistor, Variable, 20 ohms, (Trimpot)	Bourns Model 3010L
R702, PSC-411	Resistor, Variable 5K (Trimpot)	Bourns Model 3010L
R708, PSC-410	Resistor, Variable 200 Ohms (Trimpot)	Bourns Model 3010-L
PSC-411	Resistor, Variable, 1K, (Trimpot)	Bourns Model 3010-L
R711, PSC-410	Resistor, Variable, 20 ohms, (Trimpot)	Bourns Model 3010-L
PSC-411	Resistor, Variable, 1K, (Trimpot)	Bourns Model 3010-L

* Part No. given only when no commercial equivalents in size or function are available.

~ R702 used only with optional input transformer.

Designation	Description	Source & Part No.*
K701,K702, K703,K704	Relay,Plug-in,28V D.C. Latching	Potter Brumfield SL11D
TB**		
C801	Capacitor, Ceramic,Variable,7-45uufd	
C802	Capacitor, Mica,Selected at Test	Elmenco DM15
C803	Capacitor,Mica, 200 uufd, 500V,1%	Elmenco DM15
R801,R803	Resistor, Metal Film, 100K, 1/2W,.5%	NAI #801148
R807	Resistor, Metal Film, 20K,1/2W, .5%, T1 T.C.	NAI #801149
R802,R804	Resistor, Dep.Carbon, 100K,1/2W,.5%	NAI #801150
R805	Resistor, Dep. Carbon,2 mdg,1/2W,.5%	NAI #801147
R806	Resistor, Dep.Carbon,30K,1/2W,.5%	NAI #801151
K801	Relay, 28V D.C. Latching	Potter Brumfield SL11DB
TB19~	Used in PSC-411, with optional signal input transformer only.	
C1901	Capacitor, Ceramic, variable 3-12 uufd.	
C1902	Capacitor, Fixed Mylar, .0068 mfd. 100V, 5%	
R1901	Resistor, fixed,metal film, 999 K, 1/2W, 1%	NAI #801156

* Part No. given only when commercial equivalents in size or function are not available.

**Frequency and reference voltage dependent components. Above listing for 400 cps and 115 volt reference. For ther references voltages and frequencies see supplement.

~TB19 used only with optional input transformer.

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Replacement Parts List (Continued)

Designation	Description	Source and Part No.*
R1902	Resistor, Fixed, Metal Film, 990 ohms, 1/2W, 1%	NAI #801157
R1903	Resistor, Variable, 20 ohms (Trimpot)	Bourns Model 3010-L
K1901, K1902	Relay 28V D.C. Latching	Potter Brumfield SL11D

Replacement Parts List

Designation	Description	Source and Part No.
R6, R7	Resistor Fixed, W.W. 10K, 1/8W ±1/4%	NAI #800625
C6, C707	Capacitor, Fixed, 4.7 ufd, 10V Tantalum	NAI #801780

The parts listed on this supplement sheet are for the S450 and are substituted for the parts in the Standard Replacement Parts List.

Supplement #304

S/N 884	RP	S-6-C2		A
S/N 1522	RP	S-2-C1		B
S/N 1764	RP	S-10-C2		C
S/N 2022	RP	S-6-C2		D

J6

DISC. INPUT — A, B

REFERENCE 115V 400CPS — LO: F; HI: E

OUTPUT(H) — HI: G; LO: H

OUTPUT(V) — HI: C; LO: D

J7

A — K501 PIN 4
B — K501 PIN 9
C — K503 PIN 4, K502 PIN 4, K704 PIN 4
D — K701 PIN 4
E — K701 PIN 9
F — K702 PIN 8&5, K704 PIN 8&5, K703, K701, K502, K801, K501, K503 PIN 8&5
G — K702 PIN 4
H — K702 PIN 9
J — K801 PIN 4
K — K801 PIN 9, K502 PIN 9
L — K704 PIN 9, K503 PIN 2
M
N
P — K703 PIN 9

J8 — R703 PIN 4

115 V AC 50-420CPS

C1 .5mf 200V
C2 .5mf 200V
R3 10K
R10 10K
K1902
K1901
R103 999K
C102 7-45 mx
C103 7-45 mx
C104 *
C105 *
C106 *
R101 10K
C107 2-2 mx 20V
C101 7-45 mx
USED ONLY WHEN OPTIONAL REF ISOL TRANSFORMER IS USED
K1901
C702 6800 mmf
R702 50K
K704
TO J6-B
-30V-A
C707 4.7mf 10V
Z18
R15 175K
R705 2K
R712 12K
C706 1000 mmf
TC-1
TP1
TP4
T3
C41 *
T4
CR601 ING4S
R111 25Ω 3W 5%
C602 40mf 30V
G02
-30V-A
C1 .5mf 200V
C2 .5mf 200V
R3 10K
R10 10K
K1902
K1901
R103 999K
C702 6800 mmf
R702 50K
K704
TO J6-B
C101 7-45 mx
C104 *
R101 10K
C107 2-2 mx 20V
C102 7-45 mx
C105 *
C103 7-45 mx
C106 *
USED ONLY WHEN OPTIONAL REF ISOL TRANSFORMER IS USED
-30V-A
C1 .5mf 200V
C2 .5mf 200V
R3 10K
R10 10K
K1902
K1901
R103 999K
C702 6800 mmf
R702 50K
K704
TO J6-B
C101 7-45 mx
C104 *
R101 10K
C107 2-2 mx 20V
C102 7-45 mx
C105 *
C103 7-45 mx
C106 *
-30V-A
C1 .5mf 200V
C2 .5mf 200V
R3 10K
R10 10K
K1902
K1901
R103 999K
C702 6800 mmf
R702 50K
K704
TO J6-B
C101 7-45 mx
C104 *
R101 10K
C107 2-2 mx 20V
C102 7-45 mx
C105 *
C103 7-45 mx
C106 *
-30V-B
B1
C5 .5mf 200V
C6 4.7mf 10V
Z4
R6 10K 1/8W .25% W.W.
R7 10K 1/8W .25% W.W.
C41 *
T5
R801
OPTIONAL REF ISOL TRANSFORMER

D-760136 D
SHEET 1 OF 1 REV

S350 B/M A-794107
S387 B/M A-794105
S 450 B/M A-794096
S 281 B/M A-794093

NOTES:
* ALL E TO F3 E ARE ON T
** SECTIONS NOT USED WITH OPTIONAL TRANSFORMER
*** 400~ : C803 = 200 MMF
800~ : C803 = 100 MMF

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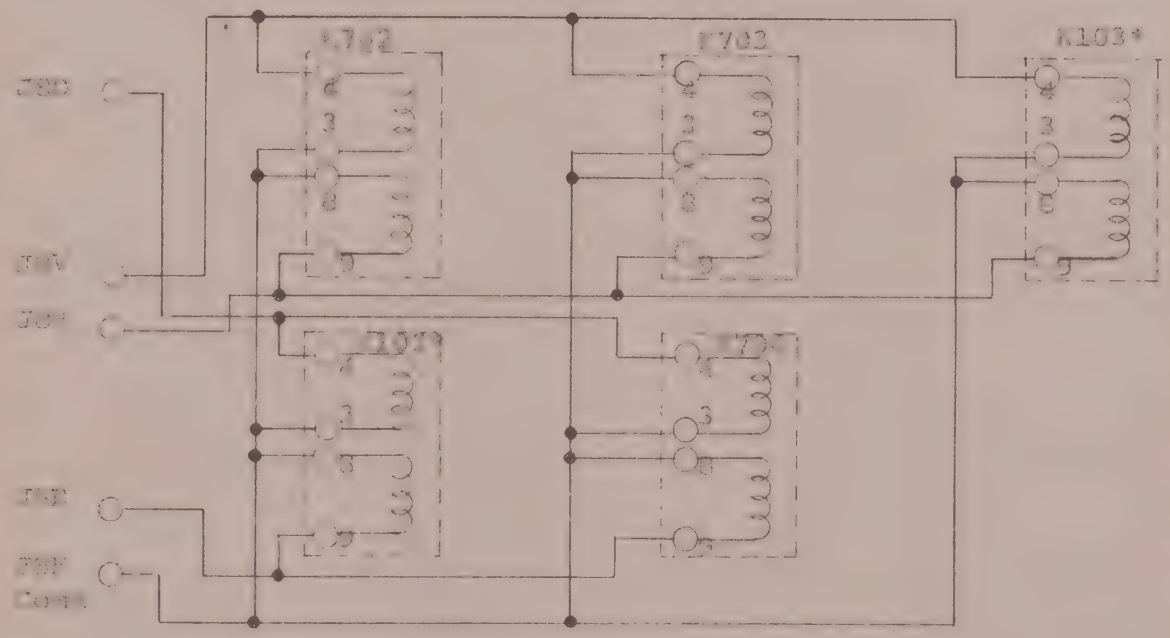
SCHEMATIC, PSC 411 — S281, S450, S387, S350

D-760136 D

for
PSC-410

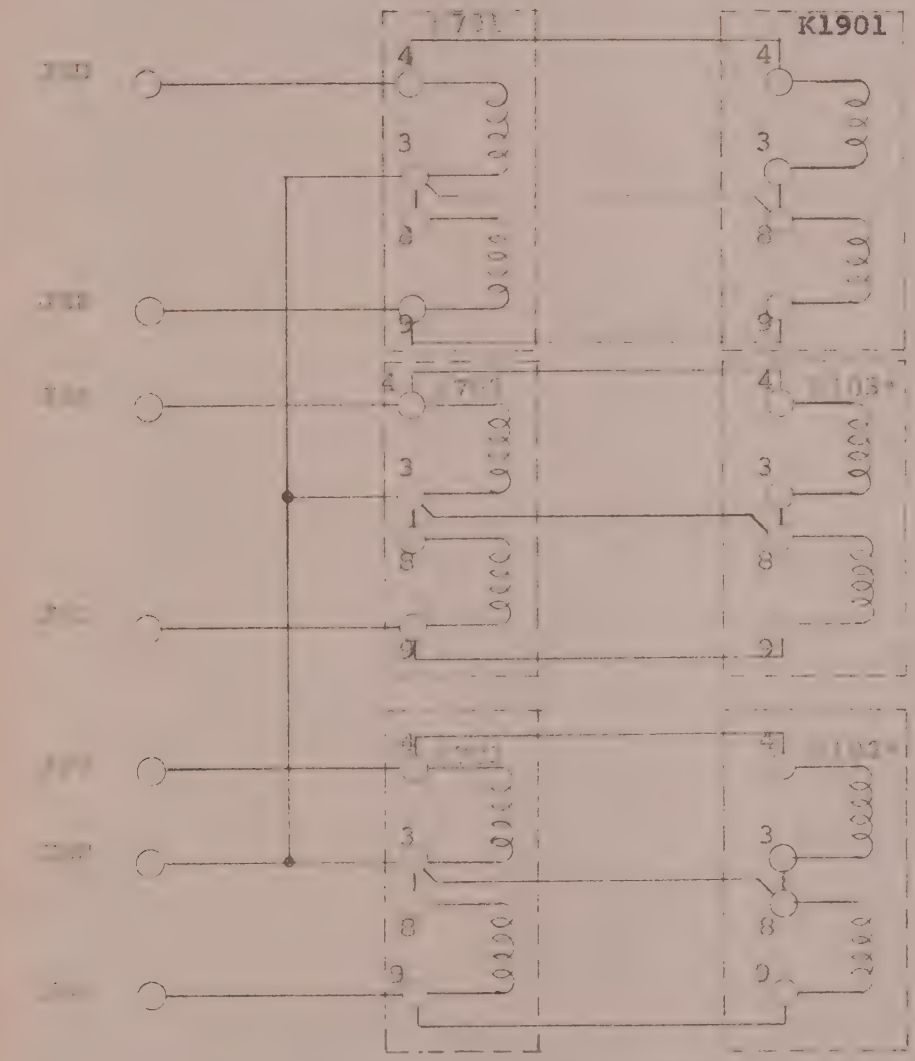


Program	+28V Program Energize	-28V Program Energize	Power
1 volt full scale	V and D	R and E	7.5 watts
10 volts Full Scale	R and D	V and E	7.5 watts
100 volts Full Scale	V and E	R and D	7.5 watts
1,000 volts Full Scale	R and E	V and D	7.5 watts

*TB-100 Series Relay (TB-1) and I-1001 (±-1V) only to units with input transformer only. All other instruments do not contain TB-1 or TB-19 and their associated components.

Fig. 5.1

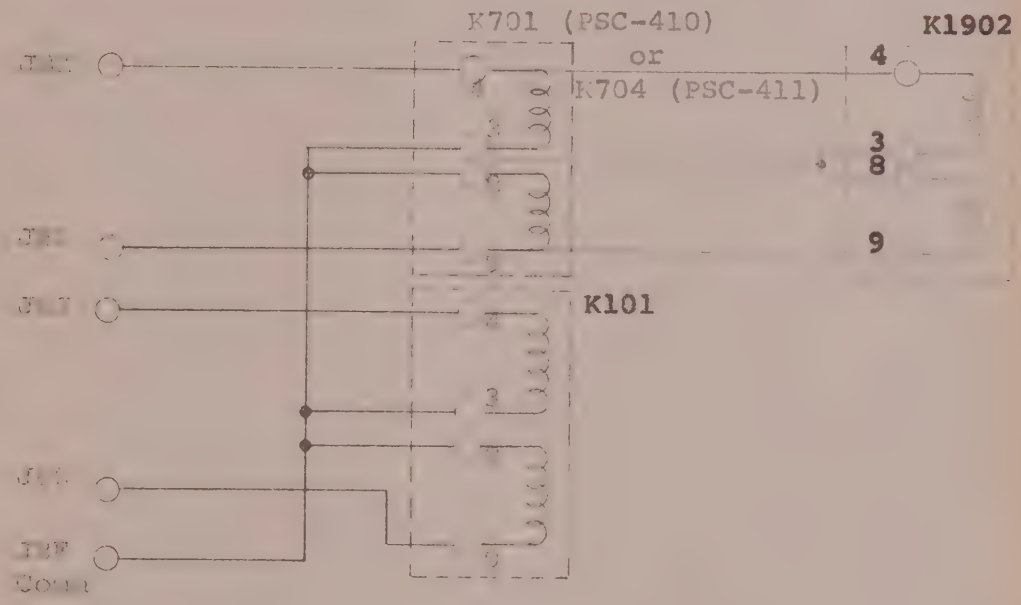
PROGRAMMING PSC-411
(6 Ranges)



	+28V Program Energize	-28V Program Energize	
10MV	DKV	ELR	3 Watts
100MV	DLR	EKV	4.5 Watts
1V	DKR	ELV	4.5 Watts
10V	EKV	DLR	3 Watts
100V	ELR	DKV	4.5 Watts
1000V	EKR	DLV	4.5 Watts

transformer only. All other instruments do not contain TB-1 or TB-19 and their associated components.

SIGNAL INPUT PROGRAMMING
for
PSC-410 & PSC-411
(FOR UNITS WITH OPTIONAL INPUT TRANSFORMER)

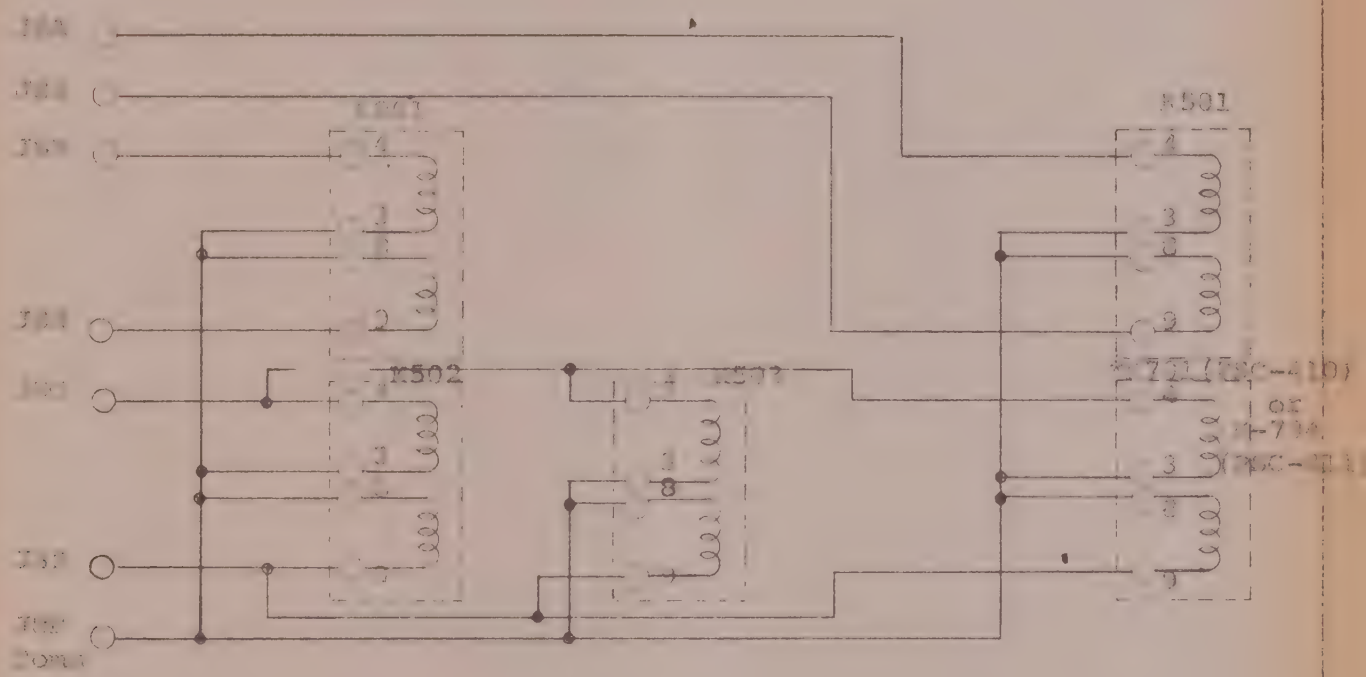


Program	+ Program Energize	-Program Energize	Power @28V
Direct (single ended)	[illegible]	[illegible]	3 watts
Floated	[illegible]	[illegible]	3 watts

For P.S.C. 411 All relays are wired in parallel and are programmed by applying 28V Signals to Pins J and U.

Fig. 5.5

PROGRAMMING CIRCUIT
for
PSC-410 and 411



Control	+ Program Energize	- Program Energize	Power @28V
Total	B and P	A and C	6 watts
Fund	A and P	B and C	6 watts
In Phase	A-M-C	B-N-P	7.5 watts
Quadrature	A-N-C	B-M-P	7.5 watts

*Becomes K104 in units with optional input transformer.

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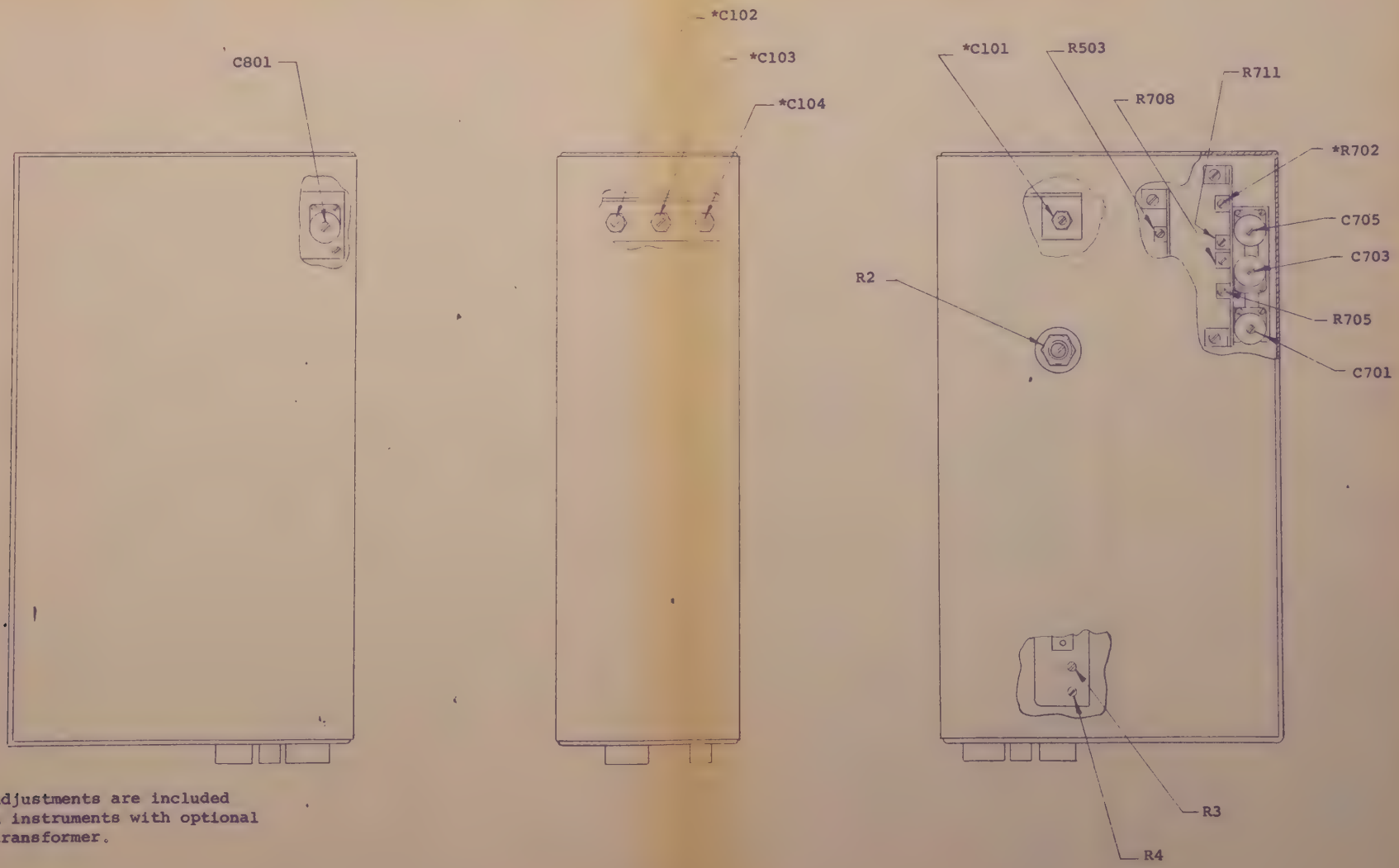
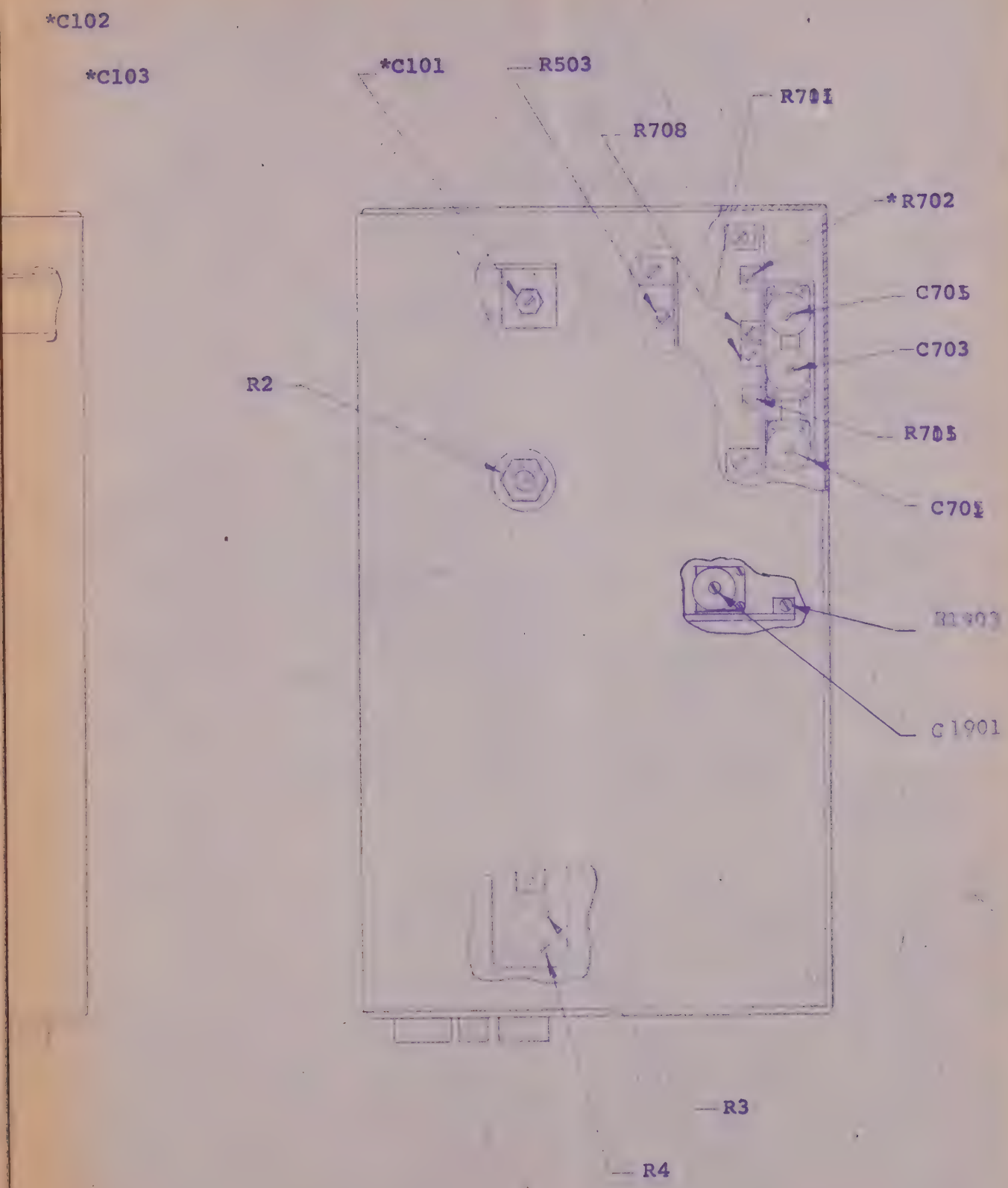


* These adjustments are included only in instruments with optional input transformer.

PSC-410

CALIBRATION ADJUSTMENT LOCATIONS
Fig. 5.7



1

ENT LOCATIONS
Figure 5.8

SECTION VI

CALIBRATION AND TEST PROCEDURE

Ecuipment Required

1. 115V signal source capable of generating frequency of operation for unit under test:

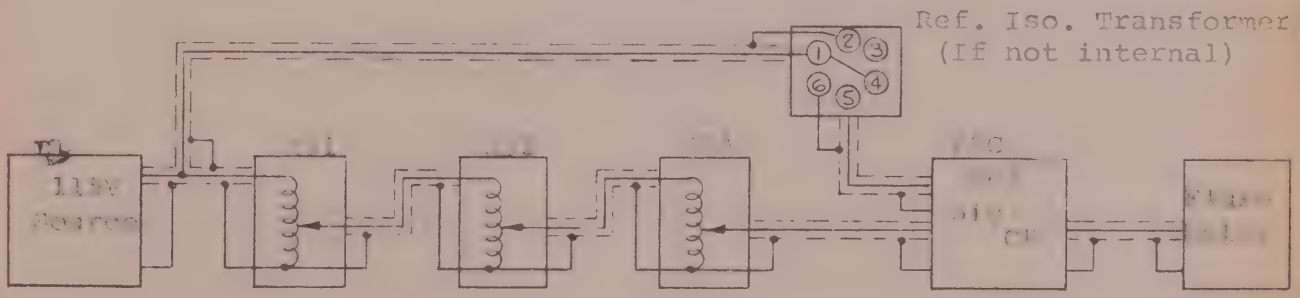
   Accuracy: Frequency ±1/2%
   Stability ±.01%
   (Elin Model RK-115-17)

2. Differential VM (A.C. & D.C.)

   Accuracy: A.C. ±0.2% (Calibrated at 100V by Holt or equal to .025%).
   D.C. ±0.05%
   (Fluke Model 803)

3. Three North Atlantic Industries, RB-503 Ratio Transformers or equal for PSC-411 or two for PSC 410.

Connect instrumentation as shown:



I. Preliminary Operational Check

The following checks are for the purpose of spotting faulty instruments before proceeding with the calibration procedure. (NOTE: All outputs should be read at the plus terminal, except where noted.)

A) Turn on instrument and check both -30V output points at power supply (indicated on schematic). Should be -30V, ±1.5V.

B) With input shorted, output should be 0 in all ranges and functions. (Less than 3 mv).

C) Set FUNCTION to "FUND", input mode to "DIRECT", and, using the most sensitive range for the instrument in use, apply the input signal equal to full scale sensitivity of that range, at the frequency of operation. Read output with Fluke meter. Adjust R3 (a screw driver adjustment under the top cover), output should vary through a full scale output of 10V. Observe waveform at feedback point (T2, Pin 5) with scope. It should remain sinusoidal for a D.C. output up to 11 or 12 volts.

D) Set FUNCTION TO "TOTAL", and repeating procedure of step D, adjust R503, found on TB5 under top cover of instrument.

E) With "FUNCTION" set to "IN PHASE" and adjusting R4 located adjacent to R3 under top cover, repeat procedure of Step D.

NOTE: Proper operation of this most sensitive range will insure correct operation in the other less sensitive ranges.

II. Calibration Procedures

A) Frequency Response Trim (Direct and Total Mode)

1. In the most sensitive range position, apply a 90% of full scale voltage to the input. Sweep the frequency of the input from 350 cps to 10 KC and note the variation of the output with respect to 90% of full scale output (9V D.C.). Adjust C502, C503 and R504 so that the maximum deviation does not exceed ±1%. (The input should be monitored with a meter which has a frequency response which does not exceed ±.1%).

2. Repeat step 1 for all available ranges after completion of the Range Calibration and Range Quadrature Trim (Section D and E).

B) Voltage Sensitive Calibration

NOTE: Use only .1 and .01 scales on ratio boxes to insure maximum accuracy. RB#3 not necessary for PSC-410).

1. "Fund" position, Most Sensitive range (As in 1D)

Set ratio box #1 to provide exactly 100V as measured by the Fluke meter. Set Ratio Box #2 to the .01 position (1V for PSC-410) and RB #3 to the .01 position (10 mv for PSC-411) adjust R3 to produce a 10V D.C. (± 2.0 mv) output from the converter.

2. "Total position, Most Sensitive range (As in 1E)

Check 100V A.C. input signal with Fluke meter. Adjust R503 to produce a 10V D.C. output.

3. "Transformer" input (Where applicable)

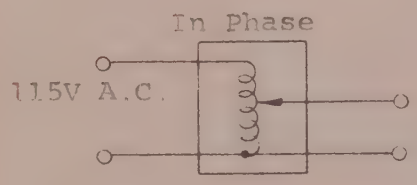
Switch input to "transformer" position. (In the case where there are both Reference and Signal Isolation transformers, internal circuit ground must be tied to chassis ground. This may be accomplished at the output terminals.) Repeat steps 1 and 2 adjusting R702 on TB 7 (See Fig. 5.7 or 5.8) for low ranges and R1903 for 10 volt range and above.

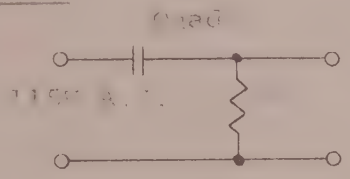
4. Check linearity in 1. 2 and 3 by switching RB3 down scale and reading corresponding voltages on Fluke. Linearity should be within 3 mv.

C) Phase Sensitive Calibration

1. In-phase and quad signal inputs are derived in the following manner:

FOR PSC-411





Other frequencies
X_C approx. 2,000 times r
R less than 200 ohms

400 cycles	800 cycles
C = .001	.001
R = 180 ohms	90 ohms

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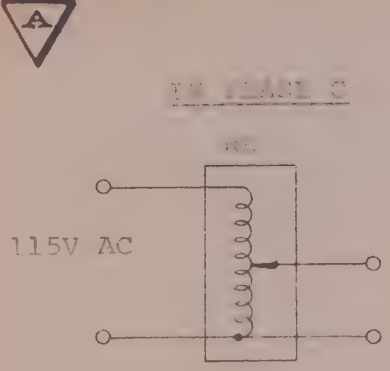

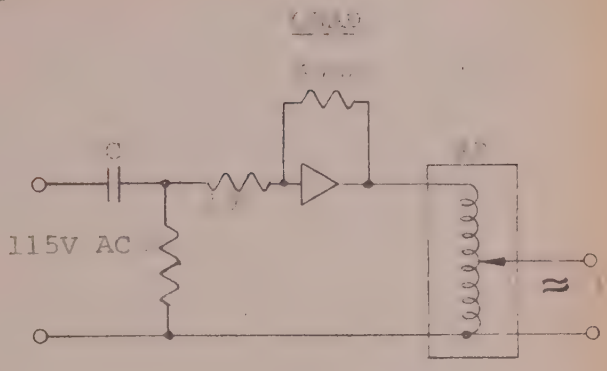

2. Orthoganality Trim

Switch converter to "IN PHASE", mode to "DIRECT" and most sensitive range. Apply a full scale quadrature signal to input by adjusting RB to approximately 1V for PSC-410, or R to provide approximately 10MV for PSC-411. Adjust R2, Phase Trim Adjustment, for 0 D.C. output. Remove quadrature signal, and with switch in "QUAD" position, apply a full scale in-phase signal to input. Adjust capacitor, C801 on TB8 for 0 D.C. output.

Set FUNCTION switch to "IN-PHASE". Check linearity with an in-phase input equal to full scale value of most sensitive range (as in B, step 4.). Repeat procedure for quadrature signal (should be within 10 mv, D.C. output.)

D) Range Calibration ("DIRECT" mode) All adjustments rate to ±2.0mv

PSC-410

1. In "FUND", 10V Range, apply 10V A.C. to input and adjust R705 on TB-7 for 10V D.C. output. In "QUAD", adjust C701 on TB-7, for zero output, Check "FUND".

2. In "FUND", 100V Range, apply 100V A.C. to input and adjust R708 on TB-7 for 10V D.C. output. In "QUAD", adjust C703 on TB-7 for zero output. Check "FUND".

3. In "FUND", 1,000V Range, apply 300V A.C. to input and adjust R711 on TB-7 for 3V D.C. output. In "QUAD", adjust C705 on TB-7 for zero output. Recheck "FUND".

PSC-411

1. In "FUND", 100 mv Range, apply 100 mv A.C. to input and adjust R-708 on TB-7 for 10V D.C. output. In "QUAD", adjust C-703 on TB-7 for a zero output. Check "FUND".

2. In "FUND", 1 V Range, apply 1 V A.C. to input and adjust R-711 on TB-7 for 10V D.C. output. In "QUAD", adjust C-705 on TB-7 for zero output. Check "FUND".

3. In "FUND", 10V Range, apply 10V A.C. to input and adjust R-705 on TB-7 for 10V D.C. output. In "QUAD", adjust C-701 on TB-7 for zero output. Check "FUND".

4. In "FUND", 100 V Range, apply 100V A.C. to input and check for 10V, D.C. output. In "QUAD" check for zero output.

5. In "FUND", 1000V Range, apply 300V A.C. to input and check for 3V D.C. output. In "QUAD", check for zero output.

E) Range Quadrature Trim (Transformer, "QUAD" Mode) All Adjustments made to ± 2.0 mv - Applicable to Units with Optional Signal Input Transformer, Only.

PSC-410

1. In 1V Range position, apply 1V in-phase input and adjust C101 on TB-1 for zero output.

2. In 10V Range position, apply 10V in-phase input and adjust C102 on TB-1 for zero output.

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PSC-410 (Cont'd)

3. In 100V Range position, apply 100V in-phase input and adjust C103 on TB-1 for zero output.

4. In 1,000V Range position, apply 300V in-phase input and adjust C104 on TB-1 for zero output.

5. Check linearity as in II-B-4 (Should be within 10mv).

PSC-411

1. In 10mv Range position, apply 10mv in-phase input and adjust C101 on TB-1 for zero output.

2. In 100mv Range position, apply 100mv in-phase input and adjust C102 on TB-1 for zero output.

3. In 1V range position, apply 1 V in-phase input and adjust C102 on TB-1 for zero output.

4. In 10V Range position, apply 10V in-phase input and adjust C1901 for zero output.

5. In 100V Range position, apply 100V in-phase input and check for zero output.

6. In 1,000V Range position, apply 300V in-phase input and check for zero output.

7. Check linearity as in II-B-4. (Should be with 10mv).

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WARRANTY

North Atlantic Industries, Inc. hereby warrants that this instrument is free from defects in material and workmanship. Liability under this warranty is limited to servicing, calibrating and replacing any defective parts with the exception of electron tubes and fuses, if, within ninety days after shipment the original purchaser notifies North Atlantic Industries, Inc. that the instrument is defective and has not been damaged in shipment. Notification should give full details of the defect, including model and serial number of the instrument. Purchaser shall then await servicing or shipping instructions from North Atlantic Industries, Inc.

Upon receipt (transportation charges prepaid) of any returned instrument, North Atlantic Industries, Inc. shall, during the warranty period, repair the instrument free of charge provided that the instrument is found to be defective and there is no evidence that it has been operated beyond its design range, has been improperly tested, or has been opened, disassembled, adjusted, modified, dropped or tampered with in any way.

In the event that repairs are necessary which are not covered by the warranty, an estimate of costs to be incurred will be submitted before any work other than determining the defect is undertaken.

NOTE

This instrument has been carefully checked and packaged. The carrier is responsible for loss, damage, or delay in shipment, and if upon receipt, the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be made by the carrier claim agent and forwarded to North Atlantic Industries, Inc. We will advise disposition and arrange for repair or replacement of the instrument.

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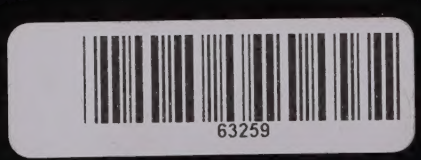
63259